

## **ERGONOMIC INTERVENTION DECREASES THE LOAD OF LEARNING AND INCREASES THE STUDENTS PERFORMANCES**

Meity Pungus<sup>1)</sup>, Adnyana Manuaba<sup>2)</sup>,  
Nyoman Adiputra<sup>2)</sup>, Ketut Tirtayasa<sup>2)</sup>

<sup>1)</sup>Postgraduate Program, Udayana University

<sup>2)</sup>Faculty of Medicine, Udayana University

Email: [meity\\_pungus@yahoo.co.id](mailto:meity_pungus@yahoo.co.id)

### **ABSTRACT**

Most students' activities in respect to the implementation of the academic curriculum are done at home. In fact, conventional activity done by the students in boardinghouse of Minahasa tradition showed unfavorable risks to students based on the load of learning with indicators of musculoskeletal complaints, boredom, and fatigue. Consequently, the students were not yet able to attain the intended performance. To overcome the problems, it has made the efforts of ergonomics intervention. In order to test the capability of the ergonomics interventions, it had been done a research with the hypothesis, the ergonomics interventions on the activity in boardinghouse of Minahasa tradition: normalizes the body temperature; decreases the musculoskeletal complaints; decreases the level of boredom; decreases the level of fatigue; increases the accuracy of working; increases the speed of working; increases the constancy of working; and increases the results of working of the students. This research was done in two periods by utilizing the treatment by subject design. The first and second period was done during four weeks, without and with ergonomic intervention. The subjects utilized in the research were as many as 15 persons. The measurements of dependent variables were done before and after doing the activity. The results of the research showed that the ergonomics interventions on the learning activities in boardinghouse could decrease load of learning significantly ( $p < 0.05$ ): the body temperature became normal, the musculoskeletal complaints decreased 44.79%; the level of boredom decreased 9.79%; the level of fatigue decreased 15.20%; the accuracy of working decreased 55.06%; the speed of working decreased 17.32%; the constancy of working decreased 30.72%; and the results of working of the students increased 131.44%. It can be concluded that the ergonomics interventions can: decrease the load of learning of the students and increase the performance of the students.

## Introduction

Most students live in the boardinghouses. Data through direct observation by Pungus (2006) around the campus of Manado State University (UNIMA) Tondano showed that approximately 80% of houses around the campus rent room to boarding students, in the traditional Minahasa. Most of activities of the students to get the grade of semester as the indicator of the results of learning, were done at home. It was clear that the conventional activity of learning in the traditional houses of Minahasa was ergonomic.

Preliminary research conducted by Pungus and Palilingan (2009) the 12 subject of students of the Faculty of Mathematics and Natural Sciences (FMIPA) of UNIMA where each performs conventional activities in the room of the traditional house of Minahasa at night at around 20:00 until 23:00 by using the guide of learning with the subject of vector, shows the following results.

Oral temperature changed from an average of  $35.80 \pm 0.32$  °C before the activity to an average of  $35.58 \pm 0.59$  °C after activity. This indicated that the students have symptoms of hypothermia (Curtis, 1995). The Score of musculoskeletal complaints increased significantly ( $p < 0.05$ ), from an average of  $40.75 \pm 5.91$  to  $67.67 \pm 11.14$  or 66.05% increased. The score of boredom increased significantly ( $p < 0.05$ ), from an average of  $68.75 \pm 6.31$  to  $83.67 \pm 12.77$  or 23.04% increased. The score of general fatigue of the students experienced a significant increasing ( $p < 0.05$ ) from an average of  $84.08 \pm 11.11$  to  $98.08 \pm 11.23$  or 16.65% increased.

The unergonomic conditions in learning room of the traditional house of Minahasa were also affecting the physical and mental abilities of the students. It was clear where their score of accuracy, speed and constancy were low after learning activities with the subject of vector for 2 hours (Sutjana & Sutajaya, 2000): accuracy,  $13.67 \pm 2.31$  number of errors (category less); speed,  $9.79 \pm 0.99$  seconds (category quite well); and constancy,  $3.66 \pm 0.38$  seconds (category enough). The accumulation of the various aspects that were not ergonomic in learning room or learning activities work systems in boardinghouse of Minahasa tradition was also clearly visible from the results of working. The students were only able to reach the outcomes of 46.06%.

It turns out that indeed there are ergonomic problems that occur in learning activities at the boardinghouse, particularly those associated with load of learning and the student performance. These problems can be solved only if done a series of interventions by taking into account the factors involved. This may be done with the total ergonomics approach

(Manuaba, 2004a; Manuaba, 2004b; Manuaba, 2005a). Based on the background of these problems, it is necessary to study the possibility of decreasing the load of learning and improving the student performance after ergonomics intervention with total ergonomics approach in learning activities at the boardinghouse.

Formulation of hypotheses based on theoretical studies and conceptual framework in this research are as follows: ergonomic intervention on learning activities in the boardinghouse of Minahasa tradition, (1) normalizes student body temperature, (2) reduces musculoskeletal complaints, (3) reduces the level of boredom; (4) reduces the level of fatigue; (5) increases accuracy of working, (6) increases speed of working, (7) increases constancy of working, and (8) increases student outcomes.

### **Material and Methods**

This research was conducted in Kelurahan Tataaran Patar, located to the Northwest of campus UNIMA in Tondano within 6 months on the second semester 2008/2009 academic year. The research was experimental research by using treatment by subject design (Colton, 1985; Dimitrov & Rumrill; Hudock, 2005). The target population was all students FMIPA Manado State University, that was, 829 people. The reached population was all students of semester II of the Chemistry Department, that was, 156 people. The size of sample was calculated by using Colton formula was 16 people.

Variables identified in this research were classified as follows. As independent variables were: (1) type of the conventional learning activity at the boardinghouse; (2) type of learning activity in the boardinghouse with ergonomic intervention through an approach which was characterized by: using ergonomic tables and chairs and bookshelves, provision of nutritional supplement in learning activities, spatial arrangement (work station), setting lighting and air circulation, breaks settings, use of protective equipment, provision of motivation to the students, improvement of information/communications, and use of electrical equipment ergonomically. As dependent variables were: the load of learning (indicators: body temperature, score of boredom, score of musculoskeletal complaints, score of fatigue) and performance (indicators: score of accuracy, score of speed, score constancy and outcomes). As control variables were: setting activities; tools/materials used; guide of learning activities, curriculum, teaching materials; types of activities; system for evaluation of learning; teachers; support of the relevant parties (owner of the boardinghouse, the leaders of department/faculty, parents/guardians, government/local

communities); type/kind of boardinghouse; size/model of the room; presence or absence of guard/owner of the boardinghouse; equipment other facilities (toilets, kitchens); age; sex; BMI; and initial knowledge.

The research procedures were briefly described as follows. The research conducted in two periods i.e. without and with intervention period. In the period without intervention subject performed the activities of unit 1 up to 4 as they usually did without any intervention. In the intervention period, the subject performed learning activities of unit 5 up to unit 8, with a series of interventions which were based on the elements of ergonomic intervention. The measurement of the load of learning and the performance were performed similar to without the intervention period, before and during activities.

## Results

The descriptive statistic of measurement results of the load of learning of the subject and the mean difference test in the period without intervention and the period with intervention summarized in Table 1.

Table 1. The Load of learning of Subject before and after Intervention and its changes.

Indicator	Period Without Intervention		Period With Intervention		Changes		Statistics	
	Average	SD	Average	SD	Value/Score	%	t/z	p
Temp.(OC)	36.2	0.43	36.54	0.31	0.34	0.94	-3.352	0.001
Mus.comp	13.44	9.08	7.42	8.00	-6.02	-44.79	-2.897	0.004
Boredom	62.20	8.34	56.11	6.26	-6.09	-9.79	3.436	0.004
Fatigue	83.99	16.54	71.22	14.08	-12.77	-15.20	4.449	0.001

The results Table 1 showed that there was a significant difference ( $p < 0.05$ ) in the load of learning (indicators: oral temperature, musculoskeletal complaints, boredom, and fatigue) of subject between the period with intervention and without the intervention.

The Performance of subject was measured with indicators: accuracy, speed, and constancy, and result of working. The descriptive statistic of measurement results of the score of accuracy, speed, constancy and outcomes of working of subject and the mean difference test in the period without intervention and the period with intervention summarized in Table 2.

Table 2. The Accuracy, Speed, Constancy and Outcomes of Working of Subject before and after Intervention and Their Changes.

Indicator	Period Without Intervention		Period With Intervention		Changes		Statistics	
	Average	SD	Average	SD	Value/Score	%	t/z	p
Accuracy	11.17	8.6	5.02	3.77	-6.15	-55.06	-2.864	0.004
Speed	7.85	1.82	6.49	1.27	-1.36	-17.32	-3.18	0.001
Constancy	5.73	3.7	3.97	3.18	-1.76	-30.72	-2.747	0.006
Outcomes	29.58	8.95	68.46	13.96	33.88	131.44	-13.258	0.000

The results Table 2 showed that there were significant differences ( $p < 0.05$ ) in the performance of the students (indicators: accuracy, speed, constancy and outcomes of working) between the period with intervention and without the intervention.

## Discussion

It was found that the average of oral temperature before and after conducting activities in the period without and with the intervention was  $36.11 \pm 0.59$  °C and  $36.20 \pm 0.59$  °C (before) and  $36.20 \pm 0.430$  °C and  $36.50 \pm 0.31$  °C (after).

The average difference in scores of complaints of all unit activities after and before learning activity in the boardinghouse of Minahasa tradition in the period without the intervention was  $13.44 \pm 9.08$ , whereas for the period with intervention was  $7.42 \pm 8.00$ , decreased 44,79% ( $p < 0,05$ ). The percentage of decreasing was far smaller than that obtained by: Purnomo (2007) who found 87.8% on industrial workers of pottery in Kasongan Bantul and Sajiyo (2008) who found 66.94% complaints of the head, 61.52% shoulder complaints, and 81.75% complaints of the limb movement on the tobacco industry "X" in Kediri East Java..

The average score of boredom after a learning activity at Minahasa traditional boardinghouse was  $62.20 \pm 8.34$ , whereas for the period without the intervention was  $56.11 \pm 6.26$ ., decreased 9,79%. The percentage of decreasing of boredom was far smaller than the percentage reduction obtained Sutajaya (2006) who obtain scores decreased 19.5%, and obtained Wijana (2008) decreased 26.40%.

The average overall score of fatigue after learning activity at Minahasa traditional boardinghouse in the period without the intervention was  $83.99 \pm 16.54$ , while for the period with the intervention was  $71.22 \pm 14.08$ , decreased 15.20%. The percentage of

decreasing in general fatigue score was lower with that obtained Palilingan (2008) who found 34.01% on the subject of students who do field practicum activities in cold regions in Rurukan, Tomohon District and Wijana (2008) who found 73.76%.

Hence, it can be argued that, compared with learning activities in the boardinghouse without intervention, the activity of the ergonomics intervention can reduce the load of learning of the student in performing the learning activities at home.

It was found that the average of accuracy, speed, constancy and outcomes of working of all units in the period of activity without the intervention were: accuracy  $11.17 \pm 8.60$  and  $5.02 \pm 3.77$  number of errors (or the level of accuracy increased 55.06%); speed  $7.85 \pm 1.82$  and  $6.49 \pm 1.27$  seconds (the level of speed increased 17.32%); constancy  $5.73 \pm 3.70$  seconds and  $3.97 \pm 3.18$  seconds (the level of constancy increased 30.72%); outcomes of working  $29.58 \pm 8.95\%$  and  $68.46 \pm 13.96$  (the score increased 131.44%). It could be argued that, compared with the learning activities in the boardinghouse without intervention, the activity of the ergonomics intervention was able to improve the performance of the students significantly in learning activities at home.

## **Conclusions and Suggestions**

Based on the results and discussion of the study, it can be inferred that ergonomic intervention on learning activities at Minahasa traditional boardinghouse can: Normalize the student body temperature significantly from mild hypothermia condition, reduce musculoskeletal complaints of the students significantly 44.79%, Reduce the level of student boredom significantly 9.79%, reduce the level of student fatigue significantly 15.20%, increase the accuracy of working of the student significantly 55.06%, increase the speed of working of the student significantly 17.32%, increase the constancy of working of the students 30.72%, and increase the outcomes of working of the students 131.44%.

Based on the results and discussion of the research, the suggestions can be formulated as follows: in the use of EBALP as a model of learning at home is recommended that teachers or lecturers actually follow the requirements that must be met so that the guidance can be used optimally; in order that the EBALP become more perfect, a further research is needed especially with regard to the elements and more specifically as part of the ergonomic intervention; learning activity by utilizing EBALP can be an alternative to the learning activity in Basic Physics courses in the FMIPA UNIMA.

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